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Engineering and Design
GREEN BUILDING TECHNOLOGY IN HAZARDOUS WASTE CLEANUP APPLICATIONS

1. Purpose. This Engineer Pamphlet (EP) identifies Green Building technologies and opportunities at Hazardous, Toxic, and Radioactive Waste (HTRW) sites and provides guidance to U.S. Army Corps of Engineers (USACE) personnel and their contractors for use of Green Building technologies at HTRW sites.

2. Applicability. This EP is applicable to all Headquarters, U.S. Army Corps of Engineers (HQUSACE) elements and USACE commands executing HTRW projects assigned to USACE.

3. Distribution Statement. Approved for public release, distribution is unlimited.

4. References. References are provided in Appendix A.

5. Discussion. Green Building technologies can be defined as those that minimize waste generation, reduce energy consumption, encourage recycling, and conserve natural resources. Green Building technology, as defined in USACE guidance, is the design, construction, operation, and reuse/removal of the built environment in an environmentally and energy efficient manner. The use of Green Building technologies for federal projects is not only good for the environment, it has been mandated by the highest levels of the Federal Government. The President, the Department of Defense, and USACE have adopted policies that mandates the use of Green Building technologies. This document is a guide to comply with Green Building policies.

FOR THE COMMANDER:

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Environmental Quality
GREEN BUILDING TECHNOLOGY IN HAZARDOUS WASTE CLEANUP APPLICATIONS

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Chapter 1
Introduction

1-1. Purpose

This Engineer Pamphlet (EP) identifies Green Building (GB) technologies and opportunities at Hazardous, Toxic, and Radioactive Waste (HTRW) sites and provides guidance to U.S. Army Corps of Engineers (USACE) personnel and their contractors for use of Green Building technologies at HTRW sites. Green Building technologies can be defined as those that minimize waste generation, reduce energy consumption, encourage recycling, and conserve natural resources. Green Building technology, as defined in USACE guidance, is the design, construction, operation, and reuse/removal of the built environment in an environmentally and energy efficient manner. For the purposes of this document, the terms Green Building Technology and Pollution Prevention are essentially synonymous.

1-2. Applicability

This pamphlet is applicable to all Headquarters, U.S. Army Corps of Engineers (HQUSACE) elements and USACE commands executing HTRW projects assigned to USACE.

1-3. References

The list of references is provided in Appendix A. In addition, an annotated bibliography of information sources and internet sites is provided in Appendix B.

1-4. Abbreviations and Acronyms

See Appendix C for a list of abbreviations and acronyms used in this pamphlet.

Chapter 2
Background

2-1. Necessity of Using Green Building Technologies

a. The use of Green Building technologies for federal projects is not only good for the environment, it has been mandated by the highest levels of the Federal Government. The President, the Department of Defense (DOD), and the USACE have adopted policies that mandate the use of Green Building technologies.

b. Executive Order (EO) 13101, "Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition" (14 September 1998) has mandated the use of Green Building technologies for Federal activities including DOD and USACE. The EO requires that in developing drawings, work statements, specifications, or other product descriptions, agencies shall consider elimination of virgin material requirements, use of U.S. Department of Agriculture (USDA) designated biobased products, use of recovered materials, reuse of products, life cycle cost, recyclability, use of environmentally preferable products, waste prevention (including toxicity reduction or elimination), and ultimate disposal, as appropriate. The preamble to EO 13101 states that: "It is the national policy to prefer pollution prevention, wherever feasible. Pollution that cannot be prevented should be recycled; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner. Disposal should be employed only as the last resort."

c. Selected requirements of EO 13101 that may affect Green Building applications are summarized below. See Appendix D for the complete EO 13101.

(1) Agencies shall ensure that their affirmative procurement programs require 100 percent of their purchases of U.S. Environmental Protection Agency (USEPA) - designated items found in 40 CFR 247 (see Appendix E for the list of USEPA-designated items) to meet or exceed the USEPA guidelines unless written justification is provided. [These requirements and the Federal Acquisition Regulation (FAR) under which the USACE must operate are discussed in the Principal Assistant Responsible for Contracting (PARC) Instruction Letter 99-2. Documentation and reporting requirements are described in Paragraph 12(f) of the PARC Instruction Letter 99-2. The contents of the PARC Instruction Letter are provided in Appendix F.]

(2) Regulators have the authority under the Federal Facilities Compliance Act and section 6002 of the Resource Conservation and Recovery Act (RCRA) to evaluate compliance for Affirmative Procurement [EO 13101 Part 4, Sec. 403 (c)] during multimedia inspections of facilities (see Success Stories, Paragraph 5-5, Grand Forks Air Force Base).

(3) When developing, reviewing, or revising specifications, product descriptions, and standards, agencies shall consider recovered materials and any environmentally preferable purchasing criteria or energy efficiency criteria and ensure compliance with the criteria; otherwise, the Environmental Executive of the agency must provide justification.

(4) As items containing recovered materials have been designated by the USEPA, agencies shall modify their affirmative procurement programs.

(5) Agencies are encouraged to implement pilot programs to test and evaluate the principles of the Acquisition of Environmentally Preferable Products and Services and Energy Star products and materials (see Appendix E).

(6) Once the USDA Biobased Products List has been published, agencies are encouraged to modify their affirmative procurement program to give consideration to those products.

(7) Contracts at government facilities shall include provisions that obligate the contractor to comply with the requirements of this order.

d. As stated in the Defense Environmental Network and Information Exchange (DENIX) pollution prevention (P2) web page (http://www.denix.osd.mil/), pollution prevention supports the DOD's goals for readiness, quality of life, and modernization. Through resource conservation, source reduction, and recycling, pollution prevention programs assist DOD in:

(1) Enhancing operational readiness by minimizing the environmental challenges associated with every stage in the life cycle of a weapon system.

(2) Reducing health and safety risks to its personnel and neighbors in nearby communities while protecting the installation's natural resources.

(3) Reducing or eliminating compliance and cleanup problems.

(4) Implementing process improvements to increase productivity and quality.

(5) Curbing the growth of the environmental budget by eliminating rather than treating or cleaning up pollution problems, and improving the effectiveness of other DOD operations, maintenance, and procurement budgets through more efficient use of materials and resources.

e. In addition to these mandates for using Green Building technologies, USACE personnel should conform to Corps of Engineers Guide Specification (CEGS) 01355: "Environmental Protection".

2-2. Other Directives Mandating the Use of Green Building Technologies

a. There are many federal laws, executive orders, and executive memoranda that mandate energy and resource conservation and recovery for Federal activities. Early efforts include:

(1) Energy Policy and Conservation Act of 1975.

(2) Resource Conservation and Recovery Act (RCRA) of 1976.

(3) National Energy Conservation Policy Act of 1978.

(4) Federal Energy Management Improvement Act of 1988.

(5) Pollution Prevention Act of 1990.

(6) Energy Policy Act of 1992.

b. Recent directives for federal activities that relate to the use of Green Building technologies at HTRW sites include:

(1) Executive Order 13101 (September 14, 1998) "Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition" directed federal agencies to consider recycling and the use of recycled material (this EO revoked and replaced EO 12873).

(2) Executive Order 12902 (8 March 1994), "Energy Efficiency and Water Conservation at Federal Facilities," encouraged the use of energy-efficient processes for industrial facilities and the procurement of energy-efficient products.

(3) Executive Order 12845 (23 April1993), "Purchasing Energy Efficient Computer Equipment."

(4) Executive Order 13123 (8 June 1999), "Greening the Government Through Efficient Energy Management."

c. More details of these directives and other directives and topics can be found at: http://www.eren.doe.gov/femp/greenfed/. The text of Executive Orders can be found at the White House web page: http://www.whitehouse.gov/search/executive-orders.html.

d. USEPA and DOE have a joint incentive program called "Energy Star," which provides information on and acknowledges products that are both economical and energy efficient (http://www.epa.gov/energystar).

2-3. Federal Acquisition Regulation (FAR)

a. The document, "The Affirmative Procurement Program," from the Office of the Secretary of Defense (August 1994), states that 100 percent of Defense purchases of procurement guideline items must meet or exceed guideline standards unless narrowly drawn conditions are met. The Federal Acquisition Regulation (FAR) was amended to require USEPA-designated items purchased by Federal activities to meet minimum standards for recycled content (Executive Order 12873, 1995). Federal, state, and local government agencies *and their contractors* that purchase more that $10,000 worth of these products must evaluate the feasibility of purchasing these designated products.

b. New guidance regarding FARs related to USEPA's Comprehensive Procurement Guidelines (CPGs) and Recovered Materials was issued in the spring of 1999 by HQUSACE. A copy of this guidance is provided in Appendix E.

c. USEPA's Comprehensive Procurement Guidelines and Recovered Materials Advisory Notices (RMANs) are available at: http://www.epa.gov/epaoswer/non-hw/procure.htm.

2-4. Overview of Green Building Concepts

a. The goals of the Pollution Prevention Act of 1990 were to increase the elimination, reduction, or recycling of wastes. The benefits of these activities are both environmental and economical (USEPA, 1991b).

b. The environmental benefits include:

(1) Avoiding the shift of pollutants among environmental media.

(2) Reducing the need for transportation and disposal of wastes.

(3) Reducing the total waste and pollutant burden to the environment.

(4) Reducing risks of exposure to toxic substances.

c. The economic benefits include:

(1) Reducing waste management, compliance, liability, and remediation costs.

(2) Increasing operating efficiencies.

(3) Creating markets for sale or reuse of wastes.

2-5. Pollution Prevention Hierarchy

a. The Pollution Prevention Act and recent guidance developed the pollution prevention hierarchy. Under the hierarchy (USEPA, 1991b):

(1) Pollution should be prevented or reduced at the source wherever feasible.

(2) Pollution that cannot be prevented should be recycled in an environmentally safe manner.

(3) In the absence of feasible prevention or recycling opportunities, wastes should be treated.

(4) Disposal or other releases into the environment should be used as the last resort.

b. Source reduction may be accomplished through:

(1) Good operating practices (e.g., segregating waste streams such as investigation-derived waste (IDW) from different investigation sites so that reusable wastes won't be contaminated with non-reusable wastes).

(2) Technology changes: i.e., incorporating new methods that create less waste or less toxic waste (e.g., minimizing stormwater entering a contaminated excavation, thus minimizing water requiring treatment).

(3) Input material changes (e.g., using environmentally preferred products such as water-based cleaners instead of solvent-based cleaners).

(4) Product changes (e.g., converting incinerator fly ash into a soil amendment rather than disposing as waste).

c. Recycling may include:

(1) Use and reuse of waste (e.g., recycling demolition debris; using fly ash as a concrete additive).

(2) Reclamation of constituents in waste materials (e.g., extracting usable metals from sludge resulting from treatment of contaminated media). (See Chapter 5 Success Stories, Paragraph 5-3, Ashland 2 FUSRAP Site: Recycling of Uranium Tailings.)

c. The USACE document, "Report on Treatment, Storage and Disposal Facilities for

Hazardous, Toxic, and Radioactive Waste" provides information on commercial recycling and hazardous waste treatment, storage, and disposal facilities in the United States. The report provides addresses and phone numbers of commercial hazardous waste landfills, hazardous waste incinerators, deep well injection facilities, fuel blending and cement kilns, recycling facilities, and transportation operations. The report discusses relevant regulations, and it provides costs and fees for the commercial facilities.

2-6. Life Cycle Analysis

The National Institute of Standards and Technology (NIST) in cooperation with the USEPA has developed an interactive PC-based computer program that allows planners to conduct life-cycle assessments on materials they are considering for buildings. The program, called Building for Environmental and Economic Sustainability (BEES), assesses the environmental impacts of a product through its entire life cycle, from raw material, through use, to disposal (NIST, 1998).

Chapter 3
Green Building Approach

3-1. Sustainable Design of Military Facilities

a. USACE criteria for sustainable design of military facilities provide designers with guidance for the construction of all new facilities, and the rehabilitation/renovation of existing facilities. Please note that this guidance is to be followed for all USACE HTRW projects, including DOD funded projects. Sustainable Design means designing, constructing, operating, and reusing/removing the built environment (infrastructure and buildings) in an environmentally and energy efficient manner. Selected sections of the USACE criteria are summarized below.

(1) Green Building goes beyond simply using green products and recycled materials. Green Building is an environmental consciousness or resource awareness about using or not using our valuable natural resources in an energy-conscious or conservative way.

(2) The goals of sustainable design include:

- Use resources efficiently and minimize raw material resource consumption (including energy, water, land and materials), both during the construction process and throughout the life of the facility.
- Maximize resource reuse, while maintaining financial stewardship.
- Move from fossil fuels towards renewable energy sources.

(3) Integrate applicable requirements from the installation Pollution Prevention (P2) Program into the project planning and goal setting process.

(4) Make decisions during the planning and design process to support an installation-wide reduction in the release of ozone-depleting chemicals and greenhouse gases, a reduction in the use of hazardous materials and pesticides, and a reduction in the generation of solid wastes.

(5) Use energy-conserving mechanical and electrical equipment and their accessories, including lighting, that meet or exceed existing USACE criteria.

(6) Investigate the use of cleaner fuels, such as natural gas and cogeneration where remote government owned power plants are available.

(7) Designers must incorporate sustainable design through the following:

- Consider total life-cycle costs and environmental impact of products and materials rather than just initial price.
- Select materials with low embodied energy (see Paragraph 4-25).
- Avoid environmentally harmful materials (e.g., toxic substances, ozone-

depleting substances).

- Avoid excessive packaging or assure recycling of the same.
- Buy locally to minimize transportation.
- Reuse salvaged materials.
- Use products made from recycled materials.
- Select materials that can be recycled at the end of their use.
- Specify a preference for recycled-content building materials in accordance with USEPA/USACE guidance.
- Specify material designated as biobased by the USDA Biobased Products Council.

b. Further information on potential green building aspects associated with a particular technology can be obtained by contacting points of contact from the USACE Center of Expertise for HTRW Specialty List which can be accessed at: http://www.environmental.usace.army.mil/org/special/special.html .

3-2. Green Building Planning Process

a. The following process is a suggested way to evaluate an HTRW project so as to incorporate Green Building opportunities. The process would be most beneficial if it were used iteratively throughout the life of a project, from the planning phases (e.g., during planning of a site investigation, or during the Feasibility Study for a remediation project) through completion of the response action. However, the process can be used at any stage of a project to help identify Green Building opportunities and facilitate their use. In order for the process to work effectively, responsibility for managing the Green Building aspects of a project needs to be clearly defined. In addition, it is important that personnel with expertise to plan and implement all critical Green Building opportunities for a project be actively involved.

b. Figure 3-1 provides a flow chart, and Figure 3-2 provides a more detailed description of the Green Building planning process. The Green Building opportunities and technologies are discussed in Chapter 4.

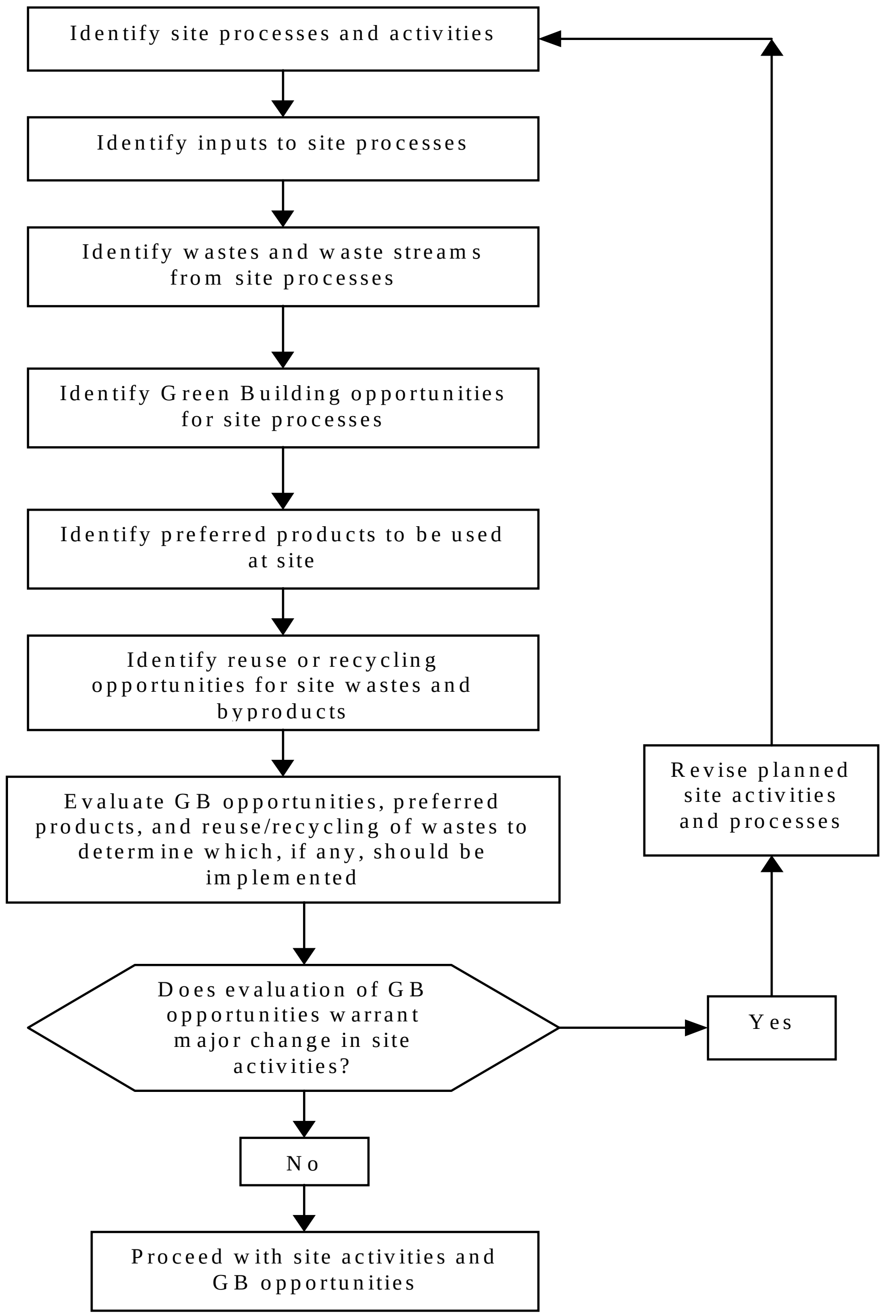

Figure 3-1. Green Building Planning Process Flow Chart

Step One

Identify processes and activities associated with the HTRW site.

Depending on the project and the phase of the project (i.e., planning for site investigations, doing the Feasibility Study, operating remedial action processes), many different processes and activities may be occurring, such as:

- Excavation.
- Product procurement.
- Incineration.
- Operation and maintenance processes (e.g., activated carbon regeneration or replacement).
- Soil or groundwater sampling.
- Clearing, grubbing, and debris removal.
- Chemical or physical remedial treatment processes (e.g., oxidation).

As part of this step, identify the person who will have primary responsibility for evaluating and implementating Green Building technologies. In addition, identify and consult personnel who are familiar with each site process or activity. For example, occupational safety and health personnel can give input on site safety, toxicities of alternative process chemicals, and risks of those processes.

Figure 3-2. Detailed Description of Green Building Planning Process.

Step Two

Identify inputs to the processes at the site.

Examples include:

- Energy to transport soils, or energy for construction.
- Energy to operate incinerators or treatment units.
- Materials and chemicals for treatment units (construction and treatment).
- Buildings materials.
- Operation and maintenance components, such as activated carbon.

Step Three

Identify wastes and waste streams.

Wastes include both materials that have been identified to be remediated and waste materials produced by the remediation process. Examples at HTRW sites might include:

- Treated water.
- Treated soils or sludges.
- Air emissions.
- Waste activated carbon/resins or other treatment residues.
- Investigation-derived waste:
    - Drilling cuttings.
    - Monitoring well purge water.
    - Decontamination wastes.
    - Personal Protection Equipment, sampling equipment, plastics.
- Treatment equipment, vessels, piping.
- Demolition materials.

Figure 3-2 (cont'd). Detailed Description of Green Building Planning Process

Step Four

Identify Green Building opportunities based on evaluation of inputs and wastes.

Green Building opportunities are activities that provide:

- Energy savings through alternative processes or operations that require less energy.
- Materials savings by:
    - Using less virgin material or use of more recycled material.
    - Using more “green” materials (e.g., those that require less energy or pollution to produce).
    - Using material that can be reused or recycled.
- Use of less toxic material.
- Less residue and waste:
    - Using treatment processes that result in less “waste” that requires disposal (see Chapter 5, Success Stories, Paragraph 5-4, Use of Cotton Coveralls instead of Tyvek).
    - Using “wastes” for beneficial purposes (e.g., using treated water for irrigation). (see Chapter 5, Success Stories, Paragraph 5-1, Mead Army Ammunition Plant: Concrete Rubble for Construction).

In this step, potential Green Building opportunities are identified and evaluated. The manager must decide whether they warrant implementation. For example, if the waste streams at a site are very small (e.g., a few feet of plastic tubing), the environmental benefits of recycling may not merit the time, energy, and money required.

Figure 3-2 (cont’d). Detailed Description of Green Building Planning Process

Step Five

Identify preferred products to be used at the site.

Use of preferred products is mandated by current EO 13101 and 40 CFR 247. Preferred products include:

- Recycled materials.
- Materials with at least the required minimum recycled content.
- Biobased materials.
- Energy efficient products.

Step Six

Identify uses or recycling opportunities for site wastes and by-products.

Many "wastes" can be used for beneficial purposes. This reduces both disposal needs and the amount of new materials needed. Examples might include:

- Use of treated water for irrigation or for wetland development.
- Use of treated soil for fill or landfill cover.
- Use of recovered fuels or solvents for energy (see Chapter 5, Success Stories, Paragraph 5-2, Holloman Air Force Base: Waste to Fuel).
- Use of demolition materials:
  - concrete rubble for aggregate (see Chapter 5, Success Stories, Paragraph 5-1, Mead Army Ammunition Plant: Use of Concrete Rubble for Construction).
  - wood for fuel.

Figure 3-2 (cont'd). Detailed Description of Green Building Planning Process

3-3. Regulatory Framework and Issues

a. Several laws and regulations govern activities at HTRW sites. It is beyond the scope of this document to discuss these in detail. However, the reader is reminded that, while working (including doing Green Building activities) at HTRW sites, all pertinent Federal, state, and local laws and regulations must be followed. The following are examples of some of the regulatory issues that may be encountered while planning or conducting Green Building activities.

b. The Resource Conservation and Recovery Act (RCRA) of 1976 and its subsequent amendments (e.g., the Hazardous and Solid Waste Amendments of 1984) set up comprehensive regulations for facilities that generate, transport, store, treat, or dispose of hazardous waste.

c. Several provisions in RCRA may affect attempts to use Green Building approaches (e.g., recycling of site materials) at HTRW sites. Some of the RCRA provisions that may affect Green Building activities at HTRW sites are as follows:

(1) Materials (e.g., soils) that are contaminated with a “listed” hazardous waste may be considered hazardous waste as long as the listed waste is present, even though the waste does not exhibit hazardous characteristics. This may preclude using these materials for beneficial purposes such as construction fill. This problem may be minimized by up-front discussions with the regulatory agencies. In addition, RCRA (40 CFR 266.20) has provisions for recyclable materials that undergo a chemical reaction that might allow recycling of hazardous wastes.

(2) Storing hazardous waste on-site for more than 90 days may trigger permit requirements (40 CFR 262).

(3) Transporting hazardous waste will trigger RCRA and Department of Transportation requirements.

d. The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) enacted in 1980 and amended in 1986 (Superfund Amendments and Reauthorization Act) developed mechanisms to manage the cleanup of abandoned hazardous waste sites.

e. CERCLA provisions that might affect use of this EP include the requirement that remedial actions must satisfy Applicable or Relevant and Appropriate Requirements (ARARs). For example, wastewater used for beneficial purposes such as for irrigation would be required to meet applicable discharge requirements for the receiving stream, and volatile emissions would be required to meet applicable local air standards. Again, up-front discussions with regulatory agencies may be helpful in determining potential ARARs. There may be opportunities to use Green Building technologies for CERCLA actions because consideration of Innovative Technologies is a requirement of 40 CFR 300.430 (e) (5) when a Feasibility Study is done.

f. The Clean Water Act (CWA) regulates discharges to surface water. The act requires National Pollutant Discharge Elimination System (NPDES) permits for point source discharges. It also established a set of pretreatment standards for discharge to sewers. The CWA requires that permits be obtained for discharges from remediation activities to surface waters.

g. The Clean Air Act (CAA) and its amendments established National Ambient Air Quality Standards (NAAQS) for certain air pollutants. The NAAQS are maintained by regulating air emissions sources. In addition to NAAQS, emissions of other hazardous air pollutants (HAPs) are also regulated under the CAA. In some Air Quality Control Regions where the air quality standards are not being met, stringent restrictions on emissions sources may be applied.

3-4. Green Building Opportunity – Site Technology Matrix

a. The following Green Building Opportunity – Site Technology Matrix (Table 3-1) matches Green Building opportunities with selected site activities common to HTRW sites. The selected HTRW site activities are primarily remediation technologies from the Federal Remediation Technologies Roundtable Matrix (http://www.frtr.gov/matrix2/section1/toc.html). Many of the site remediation technologies included in this matrix closely resemble other technologies that are not specifically identified. For example, incineration and thermal desorption have substantially the same Green Building opportunities as other ex situ thermal treatment technologies, such as hot gas decontamination and pyrolysis. Therefore, most of the Roundtable remediation technologies are represented by the selected remediation technologies in the matrix. In addition to remediation technologies, other HTRW site activities, such as building and building material management, paving, and earthwork, are included in the matrix.

b. Note that the following Green Building opportunities are applicable to essentially all of the remediation technologies and are, therefore, not included in Table 3-1: contractual issues, paper reduction, partnering, waste segregation, and mobilization. Potential uses of the Green Building opportunities at HTRW sites are discussed in Chapter 5.

Table 3-1. Green Building Opportunity - Site Technology Matrix

Green Building Opportunities	Site Technologies									
	Solidification/Stabilization	Biopiles	Composting	Slurry Phase Bio Treatment	Chemical Extraction	Oxidation Reduction	Soil Vapor Extraction	Incineration	Thermal Desorption	Excavation/Off-site Disposal
IDW Management: Solids	X	X	X	X	X	X	X	X	X	X
IDW Management: Aqueous	X	X	X	X	X	X	X	X	X	X
Direct Push Sampling							X			
Sampling Equipment Management	X	X	X	X	X	X	X	X	X	X
Plastics Management	X	X	X	X	X	X	X	X	X	X
Occupational Health Safety: PPE Management	X	X	X	X	X	X	X	X	X	X
Electrical Equipment: Sizing and Efficiency		X	X	X	X	X	X	X	X	
Activated Carbon Management		X	X	X	X	X	X	X	X	
Optimize System Operation	X	X	X	X	X	X	X	X	X	X
Piping/Process Equipment Recycling/Reuse				X	X	X	X	X	X	
Use of Package Plants/Skid-Mounted Equip	X		X	X	X	X	X	X	X	
Plant Tissue Residue Management		X	X					X		
Resource Recovery from Treatment Sludges				X	X	X				
Reuse of Treated Soil										
Stormwater Management	X	X	X	X	X	X		X	X	X
Use of Waste Organic Material, Ag Wastes		X	X					X	X	
Use of Excavations for Aquatic Habitat	X	X	X	X	X	X		X	X	X
Use of Incinerators for Waste to Energy								X	X	
Buildings, Building Material Management		X	X	X	X	X	X	X	X	

Table 3-1 (cont'd): Green Building Opportunity - Site Technology Matrix

Green Building Technologies	Site Technologies									
	Air Sparging	Bioslurping	Dual Phase Extraction	In-Well Stripping	Passive/Reactive Wall	Bioreactors	Constructed Wetlands	Adsorption Absorption	Air Stripping	Ion Exchange
IDW Management: Solids	X	X	X	X	X	X	X	X	X	X
IDW Management: Aqueous	X	X	X	X	X	X	X	X	X	X
Direct Push Sampling	X	X	X	X	X				X	
Sampling Equipment Management	X	X	X	X	X	X	X	X	X	X
Wastewater Management						X	X			
Plastics Management							X		X	
Occupational Health and Safety: PPE	X	X	X	X	X	X	X	X	X	X
Electrical Equipment: Sizing and Efficiency	X	X	X	X		X		X	X	X
Activated Carbon Management	X	X	X	X		X	X	X	X	X
Optimize System Operation	X	X	X	X	X	X	X	X	X	X
Piping/Process Equipment Recycling/Reuse	X	X	X	X		X		X	X	X
Use of Packaged Plants/Skid-Mounted Equip	X	X				X		X	X	X
Plant Tissue Residue Management							X			
Resource Recovery from Treatment Sludges						X	X	X		X
Reuse of Treated Soils						X				
Stormwater Management						X	X			
Use of Excavations for Aquatic Habitat						X	X			
Use of Dredged Material, Lake Rehab						X				
Buildings, Building Material Management	X	X	X	X		X		X	X	X

Table 3-1 (cont'd): Green Building Opportunity - Site Technology Matrix

Green Building Technologies	Site Technologies									
	Precipitation Coag.	Sprinkler Irrigation	UV Oxidation	Slurry Walls	Bldgs, Const./Demol.	Paving/Concrete Work	Earth Works	Debris/Brush Removal	Landfill Covers Liners	Site Investigations
IDW Management: Solids	X	X	X	X	X					X
IDW Management: Aqueous	X	X	X	X						X
Direct Push Sampling										X
Sampling Equipment Management	X	X	X	X	X					X
Wastewater Management	X		X			X	X			X
Plastics Management	X				X			X		X
Occupational Health and Safety: PPE	X	X	X	X	X	X	X	X		X
Electrical Equipment: Sizing and Efficiency	X	X	X		X					
Activated Carbon Management	X									
Optimize System Operation	X	X	X	X	X	X	X	X	X	X
Piping/Process Equipment Recycling/Reuse	X	X	X							
Use of Packaged Plants/Skid-Mounted Equip	X	X	X		X	X				
Plant Tissue Residue Management								X		
Resource Recovery from Treatment Sludge	X									
Reuse of Treated Soil, Soil Residue	X					X	X		X	
Stormwater Management	X		X		X	X	X		X	
Use of Excavations for Aquatic Habitat	X		X				X			
Use of Dredged Material, Lake Rehab							X		X	
Building, Building Material Management					X	X		X		

Chapter 4
Green Building Technologies, Opportunities, and Issues at HTRW Sites

4-1. Contractual Issues

Possibly the most effective Green Building Technology Opportunity for HTRW sites is to incorporate Green Building considerations into the contracts for work at the site. Contracts should state that Green Building technologies are to be used where practicable and cost-effective. The USACE PARC Instruction Letter 99-2 (Appendix F) provides guidance for meeting Federal Acquisition Requirements for Recovered Material Certification (FAR 52.223-4) and Certification and Estimate of Percentage of Recovered Material Content for EPA-Designated Items (FAR 52.223-9). Following are some examples where Green Building technologies can be stipulated in contracts:

a. Stipulate that selection of high-efficiency electrical equipment (e.g., pump and blower motors) should be considered; the Energy Star Program and Federal Energy Management Program (FEMP) should be consulted.

b. Stipulate that materials used at the site (e.g., plastic liners and covers, building materials such as siding and roofing, and process tanks) should contain recycled material to the extent practicable.

c. Stipulate that materials used at the site should be selected with future recycling potential in mind and that materials taken from the site (e.g., construction debris, packaging) should be recycled to the extent practicable.

d. Stipulate that procedures and a coordinator responsible for implementing Green Building technologies be identified as part of the site work.

4-2. Paper Reduction

HTRW activities, due to the nature of mandatory reporting, have potential to require large volumes of paper. Much of this paper is used in reports (e.g., Preliminary Assessment, Site Inspection, Remedial Investigation) detailing conditions at the site. It is common to require contractors to supply numerous copies of these reports to the site managers and regulators. Considerable paper (and consequently forest resources) could be conserved by coordinating with managers and regulators to determine what portions of the reports are needed in hard copy format and what portions could be supplied in electronic format only. The use of CD-ROMs should be considered as an electronic format because of their large storage capacity. Care should be taken in the use of various electronic formats to avoid compromise of privileged information. When hard copies are needed, double-sided duplication should be used. The PARC Instruction letter

(Appendix F) provides guidance on the use of recycled content in paper and double-sided copying.

4-3. Partnering

Management of HTRW sites can be a complex process, requiring interaction among owners, managers, contractors, and regulators. Recently, the benefits of up-front cooperative decision-making (i.e., partnering) for Green Building applications at HTRW sites has been demonstrated in the areas of solid waste diversion, energy recovery and waste minimization. Since much of the decision-making at HTRW sites is regulation-driven, major benefits from the Green Building perspective can be achieved through partnering. That is, by cooperating with regulators from the start, agreements can be negotiated for compliance with regulations in a manner that provides the greatest Green Building benefits.

4-4. Waste Segregation

a. HTRW sites often consist of several sub-sites that have a variety of contaminants and varying degrees of contamination. Considerable cost and waste handling and treatment can often be avoided if wastes are segregated. Waste segregation often allows materials with low levels of contamination or with non-listed contaminants to be handled and treated differently (and often at much less cost) than those materials with high levels of contamination.

b. It should be noted that in some instances waste segregation may not be appropriate. For example, where waste volumes are very small, or where contamination is minimal, or where treatment processes dictate blending, it may not be cost-effective or environmentally beneficial to segregate wastes.

4-5. Mobilization

Energy and money can be saved if the activities (e.g., investigation activities) are planned in a way that minimizes the requirements for personnel to be on-site and that avoids repeated mobilizations to the site. The use of qualified local drilling contractors can provide a substantial energy savings compared to mobilization from great distances. Appropriate use of the USACE Engineer Manual 200-1-2, Technical Project Planning, guidance can be useful in this regard.

4-6. Management of Investigation-Derived Waste (IDW)

a. *Solid IDW (Soil, Sludge)*. Considerable waste can be eliminated by managing investigation-derived waste (IDW) onsite. This can represent a significant cost savings depending on the volumes involved.

(1) Sometimes soil cuttings can be returned to the site of origin from the on-site staging area after they have been tested and shown to be "uncontaminated," shown to contain chemicals in concentrations below regulatory concern (i.e., by evaluating analytical data of samples from a boring), or by ensuring contaminants will be adequately addressed by the final remedial action. In this case, it is important to not mix cuttings from outside the area of contamination (AOC). In general, it is important to segregate waste streams from each other, and wastes from non-waste materials, so that in the event treatment is required, the amount of material to be managed can be minimized.

(2) Steel drums used to temporarily contain wastes such as soil cuttings and decontamination water can be cleaned and reused (minimizing the need for new drums) or sold for salvage. The state may also regulate waste metals, electrical equipment, and construction materials if they came into contact with hazardous site constituents, but may allow for reuse or recycling of the materials. In some cases, decontamination may be necessary.

b. *Aqueous IDW*. Sometimes regulatory agencies will allow decontamination and purge water to be discharged at a sampling site after the water has been sampled, tested, and shown to be "uncontaminated" or to contain chemicals in concentrations below regulatory concern. If the regulatory program and agencies will allow placing decontamination or purge water back onto the site, considerable waste can be eliminated.

(1) Alternatively, if waste water meets pretreatment requirements, it may be possible to discharge it to the local sanitary sewer. If these discharge options are not available, it may be possible to treat the water in the treatment process selected for remedial activities at the site.

(2) Otherwise this waste needs to be containerized, tested for hazardous characteristics, and disposed of (possibly in a hazardous waste facility). This can be very expensive, depending on the volumes involved. If multiple sites are sampled during a field investigation, consideration should be given to segregating wastes. If wastes from different sites are segregated, it may be possible to minimize the amount of decontamination waste that ultimately needs to be sent to a hazardous waste facility (i.e., wastes with low levels of contamination may be able to be disposed of in a municipal waste facility, such as a publicly owned treatment works).

(3) Other methods of minimizing wastes include reuse of drums and utilization of low-flow sampling methods. In particular, use of low flow (minimum draw-down) groundwater sampling methods (USEPA, 1995) results in smaller purge volumes and decreases waste disposal costs. However, it is important to remember that the sampling technique must provide representative samples and follow procedures that are acceptable to the regulators and the designer.

c. *IDW Guidance*. Two USEPA publications that describe management of investigation-derived waste are: OSWER Publication 9345.3-03FS April 1992, "Guide to Management of Investigative-Derived Waste" (USEPA, 1992) and EPA/540/G-91-009, May 1991 "Management of Investigative-Derived Wastes During Site Inspections" (USEPA, 1991a). In addition, the USACE HTRW CX has a fact sheet on IDW management that can be found at the following web site: http://www.environmental.usace.army.mil/environmental/COMPLYfs.html.

4-7. Direct Push Soil Sampling

a. Where sampling with direct push equipment is both feasible and cost effective, using this technology can significantly reduce or eliminate soil cuttings and wastes. Direct push techniques can be used to characterize site media to confirm treatment processes. In addition, any in-situ technology that requires extraction or monitoring points be installed, such as soil vapor extraction, air sparging, or bioslurping, would be a candidate for direct push technologies, for installing extraction/injection wells or monitoring points.

b. An example of direct push soil sampling is the Site Characterization and Analysis Penetrometer System (SCAPS). It was developed by the U.S. Army Engineer (USAE) Waterways Experiment Station (WES) under the sponsorship of the U.S. Army Environmental Center to provide DOD with a rapid and cost-effective way to characterize soil conditions at DOD sites that are being cleaned up. The SCAPS platform is an 18,000 kg (20-ton) truck equipped with vertical hydraulic rams that force a cone penetrometer into the ground at a speed of 2 cm/s to depths of approximately 50 m in nominally consolidated fine-grained soils. The SCAPS multisensor penetrometer probes are equipped to simultaneously measure tip and sleeve resistance to determine soil stratigraphy, layer boundaries, and soil type, as well as contaminant-specific data to determine the presence of pollutants in each soil stratum. The soil and contaminant data are collected and processed in real time, which allows investigations to visualize site conditions in three dimensions.

c. The SCAPS sensors and samplers include a Laser Induced Fluorescence (LIF) Petroleum, Oil and Lubricant (POL) Sensor, an Explosives Sensor, a Thermal Desorption VOC Sampler, a Hydrosparge VOC Sensing System, and a Multiport Sampler. Few or no soil cuttings are generated by this direct-push technology. Use of SCAPS provides other advantages. The unit can decontaminate the push rods as they are withdrawn and containerize the decontamination fluids that are generated. This eliminates the need to build a separate decontamination station for drilling equipment. A trailer-mounted grout pumping system accompanies the SCAPS truck, and test holes are backfilled with pressurized grout as the push rods and probe are withdrawn.

d. For more information about SCAPS, contact: USAE Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, Phone (601) 634-2446. The web site is: http://www.wes.army.mil/el/scaps.html.

4-8. Sampling Equipment Management

a. As much as possible, sampling equipment (e.g., stainless steel scoops and bowls) should be reused after decontamination. Recycled and cleaned drums should be considered for storing IDW. Many of the “disposable” items that are routinely discarded at HTRW investigation sites can be recycled. This is true of most plastic items such as:

- Decontamination buckets and brushes.
- Tygon tubing.
- Teflon bailers and tubing.
- Tyvek clothing.
- Inner and outer gloves.
- Respirator cartridges.

b. Many DOD facilities at which USACE HTRW activities take place have active Pollution Prevention (P2) programs. Coordinating the recycling, reuse, or disposal of such items as bailers, tubing, plastic sheeting, gloves, and Tyvek protective clothing with the facility P2 Manager can minimize waste disposal and encourage recycling.

4-9. Wastewater Management

a. Sometimes, local publicly owned treatment works (POTWs) will accept aqueous wastes if they meet pretreatment requirements. Disposal of wastewater with a local POTW should be arranged in advance of the site investigation work, and it should be discussed with the regulatory agencies who will review project reports. All appropriate documentation of waste characteristics and volumes should be provided to the POTW prior to disposal.

b. Beneficial uses of the treated water (e.g., lawn and crop irrigation, constructed wetlands) should be investigated. Sprinkling water contaminated with low levels of VOCs in sprinkler irrigation systems can be used as a “disposal” method, and it can be used to air-strip the VOCs at the same time. The use of constructed wetlands for treatment is an immediate beneficial use of the water, providing green space and ecological habitat. However, providing ecological habitat may have negative effects if bioaccumulating contaminants are present. If beneficial uses of treated water cannot be found, discharging the water to a local sanitary sewer should be considered.

c. State or local authorities may allow discharge of treated water to the ground surface. An NPDES permit may be required if the water is to be discharged to a river, stream, waterway, or other location that can be defined as a “water of the state” or “water of the United States.”

Some states define road ditches, or other normally dry drainage ways, as waters of the state if discharge to the drainage way could potentially reach surface water or groundwater.

4-10. Plastics Management

a. Most plastic items used for decontamination and sampling activities (e.g., plastic sheeting, tubs, buckets, brushes, and scrapers) are recyclable thermoplastics. These waste streams will be low volume, and bulk sale of these items is unlikely. Most items will probably have to be shipped directly to a recycler or handled through the facility P2 program. Used liners and covers should be recycled. Liners and covers should be made of recycled material where feasible. Air stripper packing should be made of recycled material. Packing material should be reused for subsequent operations if possible.

b. Generally, recyclable plastic products are made of high density polyethylene (HDPE), which includes items such as milk jugs; low density polyethylene (LDPE), including items such as polyethylene film and plastic bags; or polyethylene terephthalate (PET), including items such as soft drink bottles and clam-shell packaging.

c. The American Plastics Council maintains a nationwide list of plastics recyclers. They can be reached at (202) 974-5400 (Toll Free, 800-243-5790). In addition, planners should check with state recycling programs for information regarding recycling opportunities. Any recycling service shall be procured in accordance with Federal Acquisition Regulations.

d. Note that geomembranes and geonets used in landfills should typically not be made from recycled materials owing to the long life required by the geosynthetics. It is acceptable, however, to use regrind material in the manufacture of geomembranes and geonets. Regrind material is composed of the material created while trimming geomembranes during the manufacturing process. Some geotextiles are manufactured using recycled material. This material may be used in some non-critical applications (such as erosion control) for construction.

4-11. Occupational Health and Safety Program: Personal Protective Equipment Management

a. Recycling and reuse of materials are the primary viable Green Building opportunities for management of Personal Protective Equipment (PPE). To ensure use of Green Building technology opportunities, Green Building management practices should be specified in the Site Safety and Health Plan that is required in USACE ER 385-1-92 for all HTRW site investigation and remediation work.

b. Items such as hardhats and boots are routinely reused. Other items of PPE, such as Tyvek coveralls, gloves, and respirator cartridges, are routinely discarded. PPE waste streams are usually of low volume at HTRW sites, so sales of bulk quantities of materials to recyclers are unlikely. Recycling may still be possible by sending materials directly to a nearby recycler. DuPont has established a network of 80 recyclers across the U.S. who currently accept uncoated Tyvek and a network of 28 recyclers who accept coated Tyvek. A listing can be obtained by calling 1-800-44-TYVEK. Recycled Tyvek is suitable for applications such as plastic lumber, toys, construction fencing, park benches, and mud flaps. A barrier to recycling PPE is contamination, which may necessitate decontamination prior to recycling.

c. In addition to recycling and reuse, waste can be saved by not using more PPE than is required. For example, where site conditions permit, washable cotton and cotton/polyester blend coveralls may be used instead of disposable Tyvek coveralls. Launderable coveralls in many cases provide adequate protection in addition to reducing the PPE waste stream and associated costs. An added occupational health benefit of using launderable coveralls is the reduced heat load and heat stress for the worker because of the inherent moisture permeability of the cotton coveralls (see Chapter 5, Success Stories, Paragraph 5-4, Use of Cotton Coveralls Instead of Tyvek).

4-12. Efficient and Properly Sized Electrical Motors and Blowers

a. The selection and use of electrical equipment, including motors and blowers for USACE applications, is governed by CEGS Section 16415, Electrical Work Interior. Some rationale for using efficient electrical systems include the following.

b. Use of efficient and properly sized electric motors for blowers, pumps, and mixers can reduce energy requirements for remediation systems and building systems such as heating and air conditioning. For example, oversized blowers have to be throttled or have dilution air added. Throttling results in direct energy consumption. Dilution reduces the efficiency of subsequent off-gas treatment processes, such as activated carbon adsorption, thereby requiring more carbon to be used, or if off-gas is burned, more fuel is required to bring the dilution air to the combustion temperature, and the inherent fuel value of the off-gas is reduced.

c. Efficient electrical equipment may require a higher capital cost than standard motors. However, energy-efficient equipment saves money through using less energy, and it benefits the environment by using less electricity and consequently causing less air pollution from electrical generation.

4-13. Activated Carbon Management

a. Spent activated carbon can be disposed of in an appropriate waste facility, regenerated on-site, or returned to the supplier for regeneration. The choice between disposal and regeneration will depend primarily on the volumes involved and on the waste treated. Disposal results in a loss of activated carbon and no destruction of contaminants. Thermal regeneration saves activated carbon and destroys organic contaminants but requires energy. Steam regeneration allows reuse of the activated carbon, but it does not destroy contaminants. Activated carbon is more likely to be regenerated if a specialty contractor is used to bring it on-site and to pick up the expended carbon when it needs to be replaced. Note that the cost of regeneration may be lower than the cost of disposal if the regeneration facility is close enough to keep transportation costs low.

b. The need for exhaust air treatment depends on factors such as the type of contaminants present, concentrations, and local air regulations. Up-front discussions with regulatory agencies, and perhaps air pathway modeling, should be conducted to weigh the environmental impacts associated with treating the exhaust air compared to discharging it to the atmosphere.

c. Rather than using activated carbon to adsorb contaminants in exhaust gas, resulting in carbon waste which needs disposal or regeneration, the exhaust gas could be thermally or chemically oxidized to destroy organic contaminants. This alternative will likely require higher capital costs and use more energy than activated carbon with disposal. However, energy use may be comparable to that necessary to regenerate activated carbon.

4-14. Process Optimization

a. It may be possible to save energy by optimizing the way remediation systems operate based on factors such as spacing and orientation of injection and pumping wells and injection and pumping rates for groundwater remediation. Locating treatment units (e.g., incinerators) near the waste sources can minimize fuel use for transporting contaminated media to the treatment unit and treated media to disposal sites.

b. Energy can be conserved by staging operations to minimize handling and transporting contaminated media.

c. Wastes, such as plastic sheeting, can be saved by optimizing the size of treatment units, such as decontamination pads. The components used to construct a decontamination pad should also be reviewed to ensure that the pad is not more complicated than necessary.

d. Oxygen monitoring can be used to optimize air flow rates at bioventing, biopile, and composting operations, and it can be used to ensure that adequate oxygen is present for biological activity. Oxygen concentrations beyond these levels do not significantly enhance the biological activity. The efficiency of technologies such as bioventing can often be improved if the process is designed to treat contaminants in-situ, thus avoiding the need for ex-situ treatment.

e. Energy can be saved at soil vapor extraction sites by minimizing flow rates or by cycling pumps after the removal of contaminants has become diffusion-limited. Using air injection methods rather than extraction/injection methods where possible can save energy and resources. In addition, the use of dilution air to control vacuum should be avoided.

f. Matching the requirements of solidified waste with the use of solidification amendments could save resources such as cement or could encourage use of waste materials such as fly ash. For example, arbitrarily high unconfined compressive strength requirements should be avoided in non-critical applications. Also, using specialized solidification reagents such as phosphates or silicates may reduce the amount of cement needed to solidify contaminated soils.

g. Investigation costs and wastes can be minimized by optimizing analytical needs. Only chemical testing that is required to meet the needs of the project should be done. For example, if it is known that petroleum hydrocarbons are the chemicals of concern at a site, it may not be necessary to test for unrelated chemicals, such as pesticides. In addition, it generally is not necessary to specify detection limits that are more stringent than those required to make site remediation decisions (e.g., risk-based levels).

h. Remediation system efficiency should be periodically evaluated in accordance with the Remediation System Evaluation (RSE) Instruction Guide available to USACE personnel at http://w3.environmental.usace.army.mil/library/guidance/remcheck/remcheck.html. Use of the USACE EM 200-1-2 Technical Project Planning guidance can be helpful to ensure that site activities are efficiently planned and carried out.

4-15. Piping/Process Equipment Recycling/Reuse

a. Piping and electrical wiring from process equipment may be recyclable. Process tanks and other equipment may also be able to be recycled or reused. Electrical and control equipment can often be salvaged and reused. When designing remediation process equipment, consideration should be given to using materials with recycled content and to using materials that can be reused or recycled. This could include piping, tanks, and plastic liners. Materials and equipment that have come into contact with contamination may need to be decontaminated before recycling or reuse.

b. There is a fact sheet at the HTRW CX homepage on how to manage scrap metal that may be sent for recycling. The fact sheet can be accessed at: http://www.environmental.usace.army.mil/info/technical/comply/complys/complys.html#guidance.

4-16. Use of Packaged or Skid-Mounted Treatment Vessels

a. Where possible, packaged treatment vessels or remediation equipment should be used so that they can be reused after treatment is finished. This will eliminate the need for trying to recycle parts of the reactors and disposing of parts that can’t be recycled.

b. As an example, Corps of Engineers Guide Specification CEGS 11225 discusses the requirements for the use of modular (packaged) treatment vessels for treatment with activated carbon. The CEGS states that, “Transportable units should be considered for units containing less that 900 kg (2,000 pounds) of activated carbon...,” and that, “Modular units need not be new if pressure rating and all other requirements of this section are met.”

4-17. Plant Tissue Residue Management

a. It may be possible to find beneficial uses for plant tissue derived from processes such as phytoremediation or from brush clearing rather than disposing of them in a hazardous waste facility. For example, it may be possible to burn these materials for energy (e.g., as firewood, in cement kilns, or in incinerators). The materials may be shredded and used for mulch or soil amendments (e.g., for composting operations or pretreatment materials for soils requiring incineration). Woody vegetation may be used for paper pulp, firewood, or construction material, rather than being disposed of in a hazardous waste facility. The use of these materials likely depends on the level and types of contaminants present.

b. State or local requirements may require management of the plant tissue as hazardous waste, if regulatory threshold concentrations are exceeded. Even if the wastes are not defined as hazardous, they may be defined as “special” or industrial solid wastes, with more restrictive management and disposal requirements than municipal solid waste. Therefore, up-front discussions with regulatory agencies are needed in the project planning.

4-18. Resource Recovery From Treatment Sludges

Depending on the contaminants that are present (e.g., precious metals) and on the volumes of waste generated, it may be feasible to further concentrate the contaminants and to use another technology (e.g., mining technologies) to recover them for recycling. This is likely to be practical only where one principal contaminant is recovered and where that contaminant has a relatively high resale value (see Chapter 5, Success Stories, Paragraph 5-3, Ashland 2 FUSRAP Site: Recycling Uranium Tailings).

4-19. Reuse of Treated Soils and Soil Residues

a. Where treated soil cannot be replaced in the original excavations, consideration should be given to using the treated soil for beneficial purposes, such as construction fill, landfill cover material, or asphalt additive.

b. Stabilizing reagents from local waste streams, such as fly ash, should be considered for soil stabilization. If treated soil can be used for beneficial purposes, it may be possible to leave the excavation unfilled and use it for aquatic or wetland habitat (see Chapter 5, Success

Stories, Paragraph 5-6, IAAP: Innovative Use of excavations and Dredged Material). If the stabilized soil can be used for beneficial purposes, it may be possible to recover some of the cost of the stabilization process.

c. Up-front partnering with regulatory agencies may be useful in obtaining permission for final disposal solutions (e.g., using stabilized soil for construction fill and using the unfilled excavation for aquatic habitat). In addition, up-front discussions about the engineering properties (e.g., compressive strength) of the treated soils may result in more optimum use of resources and waste materials.

4-20. Stormwater Management

Limiting the quantity of precipitation and resulting stormwater that contact contaminated media (e.g., excavations with residual contamination, soil stockpiles, bioremediation piles) will conserve energy and treatment resources, such as activated carbon, by limiting the amount of water that needs to be treated. Stormwater can be managed by use of covers, liners, and flow diversion ditches and berms.

4-21. Use of Waste Organic Materials and Agricultural Wastes

Local waste material (e.g., agricultural waste such as corn cobs, feedlot bedding) should be considered as soil amendments for composting or pretreatment before incineration.

4-22. Use of Excavations For Aquatic Habitat

If treated soil can be used for beneficial purposes such as construction fill or landfill cover, it may be possible to leave excavations unfilled and use them for aquatic or wetland habitat (see Chapter 5, Success Stories, Paragraph 5-6, IAAP: Innovative Use of excavations and Dredged Material). Care must be taken, however, when residual contamination (especially bioaccumulating contamination) remains in the excavations. In addition, it may be necessary to obtain a CWA 404 Dredge and Fill Permit from the USACE when creating or altering a wetland.

4-23. Use of Incinerators For Waste to Energy Processors

Depending on the planned operation schedule, the location of the treatment facility, and on the media and contamination to be incinerated, it may be possible to use incinerators or other thermal processors in a waste-to-energy operation. Wastes that could be used for energy might include used tires, wood, recovered fuels, or recovered solvents (see Chapter 5, Success Stories, Paragraph 5-2, Holloman Air Force Base: Waste to Fuel). In addition, the fuel value of extracted gasses (e.g., from landfills) should be considered.

4-24. Use of Dredged Material/Lake Rehabilitation

When topsoil is needed for a site, it may be possible to get it by dredging a local water body. This can provide excellent topsoil, while removing unwanted sediment from the water body (see Chapter 5, Success Stories, Paragraph 5-6: IAAP: Innovative Use of Excavations and Dredged Material). The dredging should be done with the oversight of local wildlife agencies so that it improves aquatic habitat in the water body. Note that it is necessary to obtain a 404 Permit from the USACE when dredging from a water body identified as "waters of the United States."

4-25. Building and Building Material Management

a. Where possible, use of existing buildings at or near the HTRW site should be considered. This will eliminate significant amounts of building materials and wastes if buildings need to be dismantled. If existing buildings cannot be used, it may be possible to construct a building that will have a use after HTRW activities are finished. The buildings could be sold or transferred as appropriate. This will reduce waste because demolition will not be necessary.

b. When planning building construction, prefabricated buildings should be considered because they typically create less waste than buildings constructed on-site. When planning and constructing buildings that will be dismantled after HTRW activities are finished, the potential recycling and reuse of building components should be considered. For example, concrete rubble may be used as fill, or crushed and used in new concrete, or used directly as road cover. Electrical equipment, heating equipment, plumbing and fixtures, and ventilation blowers can be salvaged and reused. Sheet metal can be recycled. Wood sheeting and dimensional lumber can be salvaged and reused, or used as fuel. Windows and doors can be salvaged and reused (see Chapter 5, Success Stories, Paragraph 5-1, Mead Army Ammunition Plant: Use of Concrete Rubble for Construction).

c. Insulation should be made of recycled materials. For example, cellulose insulation is made from recycled paper or cotton waste. Managers should stipulate that no CFCs be used as the propellant when blowing insulation into building spaces.

d. Consideration should be given to the "embodied energy" of materials selected for construction of HTRW buildings. Embodied energy is the energy required to extract, transport, process, install, and dispose of or recycle the materials. As examples, the embodied energy ratings of several materials are as follows: concrete is 1.2 – 2, lumber is 4 – 7, particle board is 14 – 20, and steel is 25 – 39 (Cole and Rousseau, 1992). More information can be found on the Federal Energy Management Program's (FEMP) web site (http://www.eren.doe.gov/femp/greenfed/).

e. USACE criteria for Sustainable Design for Military Facilities provides guidance to designers of new Army facilities, as well as the rehabilitation/renovation of existing facilities (see Paragraph 3-1 for more details). In addition, the NIST computer program, BEES (Building for Environmental and Economic Sustainability), provides planners a PC-based life-cycle assessment tool to help them select building materials that are both environmentally friendly and cost effective.

f. Economic analysis (and decision analysis) tools for energy-saving Green Building technologies can be found in the FEMP web page. The FEMP web page provides access to the National Institute of Standards and Technology's "Building Life-Cycle Cost" computer program, which helps evaluate costs and benefits of energy conservation projects in facilities. The program can calculate annual and life cycle CO_2, SO_x, and NO_x emissions for building energy systems. While this program is intended for permanent facilities, the information could be useful for selecting equipment for HTRW facilities as well. The site also provides access to the NIST life cycle analysis program (BEES). Another web page that provides useful information regarding energy-efficient motors can be found at: http://energy.copper.org/motorad.html.

Chapter 5
Success Stories

5-1. Mead Army Ammunition Plant: Concrete Rubble for Construction

a. Part of a remediation plan at the Mead Army Ammunition Plant near Mead, Nebraska, required demolition, removal, and disposal of concrete structures at the site. This plan was modified to allow reuse of about 70 million kg (77,000 tons) of broken concrete containing trace amounts of explosives (RDX). The concrete is currently stockpiled by the Clear Creek Drainage District in Nebraska for use as rip-rap along Salt Creek, and by Saunders County, Nebraska, for use as road base.

b. By treating this material as a resource, rather than a waste, the costs associated with disposal of the material, such as hauling expenses and landfill tipping fees, were avoided. In addition, energy use was minimized in several ways: by reusing the material near the point of generation, less energy was expended than in transporting the material to a remote landfill, and no energy was expended at a landfill to place and cover the material. The energy to be expended by the drainage district and the county in reusing the broken concrete would have been expended in using material from another source; in fact, their energy usage was minimized by providing them with a nearby source of rip-rap and road base.

5-2. Holloman Air Force Base: Waste to Fuel

a. A free product recovery system at Holloman Air Force Base was designed to remove JP-4 jet fuel from the water table aquifer, where approximately 2.3 million liters (600,000 gallons) was present as free product. During the design, the problem of how to dispose of the recovered JP-4 became a significant issue because of anticipated high recovery volumes. Designers determined, through pre-design sampling, that the JP-4 was of sufficient quality (following reclamation) to be used as fuel for an on-site thermal oxidizer that was used to treat fuel vapors extracted from the groundwater and vadose zone. The JP-4 recovered from the treatment system was first processed through an oil/water separator and then filtered before being reused as fuel for the thermal oxidizer. Although backup fuel was available, the majority of the time the thermal oxidizer was being powered by the JP-4 reclaimed from the water table.

b. The designers for this project showed ingenuity in the area of pollution prevention. Not only did they avoid costs and regulatory issues associated with the transportation and disposal of potentially hazardous materials/wastes, they also found a way to significantly reduce the cost of fuels required to complete site cleanup.

5-3. Ashland 2 FUSRAP Site: Recycling of Uranium Tailings

a. The Ashland 2 Formerly Utilized Sites Remedial Action Program (FUSRAP) Site in Tonawanda, New York is contaminated with low levels of radium, uranium, and thorium. The contamination is a result of work done as part of the nation's early atomic energy program, when uranium ores were processed at the former Linde Products Division of Union Carbide. From 1944 to 1946, uranium processing wastes were transported from Linde to a 4 hectare (10-acre) area, known then as the Haist property, now called Ashland 1. Subsequent activities in the 1970s resulted in some of the material being transported to an area now known as Ashland 2.

b. Recycling of radioactive contaminated soils involved shipping the material to the International Uranium Corporation (IUC) Mill in Utah. Since the Nuclear Regulatory Commission licenses the facility, an amendment to their license was required to accept the Ashland material. Previously, the Department of Energy had shipped this type of material exclusively to another facility in Utah. Opening up the disposal/recycling market for this type of material not only benefitted the Ashland project, but other FUSRAP projects, as well.

c. The initial cost savings for recycling were estimated at about \$40/m^3 (\$30/cy), which equates to about \$1.5 million for the 34,000 m^3 (45,000 cy). However, the actual costs avoided turned out to be in excess of \$16 million. This is because IUC was able to accept materials for which other facilities would have charged higher rates, such as debris and petroleum contaminated soil, for the same low unit price. The streamlined manifesting procedures and more flexible acceptance criteria for water content also resulted in cost savings.

d. The more flexible acceptance criteria at IUC resulted in significant savings in time. The biggest factor was that IUC did not have the strict water content limitations that some other facilities mandate. This allowed the material to be excavated and shipped "as is" without requiring treatment to meet a specific water content standard. Additionally, rail car turn-around times were quicker than have been historically reported using other disposal facilities.

e. In addition to the noted savings in time and money, recycling of the material at IUC offered other important benefits. From a public relations standpoint, it was a success story to be able to explain that at least some of the material that was being removed from the site would be recycled. This not only resulted in recovery of an important resource, but also resulted in the material ultimately put in the ground being less contaminated. Overall, recycling of the material at IUC resulted in significant savings and fostered a positive image of the Corps as steward of both the environment and taxpayers' money.

5-4. Use of Cotton Coveralls Instead of Tyvek

a. The contractor at the Weldon Spring munitions facility has begun waste reduction by using cotton coveralls instead of Tyvek suits for workers' dermal protection in non-critical situations. The Weldon Spring site, near St. Louis, Missouri, is an abandoned munitions manufacturing facility where soils and other media are contaminated with explosives (primarily TNT). The remedial action at the site is primarily incineration of soils. Many of the site workers are engaged in activities that do not require high levels of dermal protection (i.e., cotton coveralls provide adequate dermal protection). The cotton coveralls are initially more expensive than Tyvek suits. However, the cost of the cotton coveralls and their laundering is less than the cost of several hundred Tyvek suits per day for several months.

b. In addition to saving money, the use of the cotton coveralls saves a significant amount of solid waste at the site. Since an estimated 120 workers are involved with the program, an estimate of nearly 300 Tyvek suits would have been used per day for several months of site activities.

5-5. Grand Forks Air Force Base: Multimedia Inspection

a. Under Section 6002 of the Resource Conservation and Recovery Act (RCRA), state regulatory agencies are empowered to evaluate adherence to Federal Procurement Guidelines for Federal facilities and activities. During a RCRA audit at the Grand Forks Air Force Base in Grand Forks, North Dakota, the state regulatory agency found that the base had proper procurement procedures in place and was adhering to the procurement policies.

b. In addition to evaluating day-to-day procurement procedures for the base, the state evaluated the USACE procurement procedures for the military construction activities that it oversees there. The Corps personnel were able to refer to the CEGS, which have been revised to meet sustainable design requirements.

c. Because the base and the USACE personnel involved with base military construction had proper procurement procedures in place and were following the procedures, the audit found no deficiencies, and the inspection can be considered a success. However, the experience points out that these audits can and will be made, and that Federal Procurement Guidance must be followed.

5-6. Iowa Army Ammunition Plant: Innovative Use of Excavations And Dredged Material

a. The Iowa Army Ammunition Plant (IAAP) is an active munitions manufacturing facility in southeastern Iowa. Historical activities at the plant contaminated the soil, surface water, and groundwater with explosives. The site soils are being remediated through excavation and thermal desorption of the explosives. Since the site is large, significant quantities of soils have been excavated. These excavations would typically require refilling with clean soils at considerable expense (estimated in excess of a million dollars). At IAAP, partnering with regulatory agencies allowed the excavations to remain unfilled and converted to small lakes and wetland areas. Residual contamination that leaches into the water bodies from the soils surrounding the excavations is then treated via phytoremediation processes by the aquatic plants.

b. In addition to the creation of surface water resources from excavations, IAAP developed an innovative use for dredged material from a local small lake. The lake, located on the IAAP facility, suffered from significant sedimentation problems, and the aquatic habitat was seriously degraded. The planners for the remedial activities at IAAP, in cooperation with the appropriate wildlife agencies, drained the lake and excavated sediment from the lake bottom. By excavating the lake bottom in a specific manner, aquatic habitat could be restored in the lake. This renovated the lake, restored its aquatic habitat, and provided IAAP with large quantities of high quality topsoil for regrading at remediation sites.

c. The program at IAAP not only was successful in saving significant tax dollars, but the created water bodies provide aquatic habitat for local wildlife and recreational opportunities for local residents.